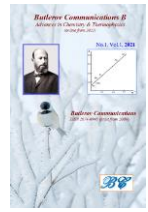
BUTLEROV HERITAGE

Butlerov Communications B
Advances in Chemistry & Thermophysics
ISSN 2074-0948 (print)

2021. Vol.1, No.1, Id.17.
Journal Homepage: https://b-journal.butlerov.com/



Thematic section: Software Development.
Subsection: Inorganic Technology.

Full Paper

The Reference Object Identifier – ROI-jbc-B/21-1-1-17
The Digital Object Identifier – DOI: 10.37952/ROI-jbc-B/21-1-1-17
Received 18 March 2021; Accepted 20 March 2021

Metrological characteristics of the determination of chromium using separation of the useful signal from noise, background, harmful signals by the emission spectra of steels

Insaf I. Shakiryanov, **Sait A. Bakhteev**, **Artem S. Maltsev**, and **Rafail A. Yusupov***[+]
Department of Analytical Chemistry Standardization and Quality Management. Kazan National Research Technological University. K. Marx St., 68. Kazan, 420015. Republic of Tatarstan. Russia. Phone: +7 917 390 3168. E-mail: yusupovraf@yandex.ru

*Supervising author; [+]Corresponding author

Keywords: emission spectrometry, useful signal extraction, metrological support.

Abstract

In the method of laser-spark emission spectrometry (LIBS), due to the burning of a local portion of the sample and the creation of plasma, the effect of the surface is negligible. This circumstance makes it possible to analyze steels without preliminary polishing. Also, the ability to focus laser radiation allows for local and layer-by-layer analysis of various composite materials and coatings. The LIBS method covers a wavelength range of approximately 190-950 nm. The reproducibility of the spectra depends mainly on the physical characteristics of the sources of excitation of the spectra – temperature, electron concentration, the residence time of atoms in the excitation zone of the spectra, and the stability of the source regime. In this work, it is proposed to use the SPECTRUM and METROLOGY software products, created by the authors of this work, to discriminate noise, background and harmful signals from a useful signal in manual and automatic modes. After identifying the principal components, detecting noises and misses, and determining the values and intervals of oscillations of the principal components, the stage of mathematical modeling of the spectra follows. On the basis of an integrated system consisting of modern equipment, standard samples and spectra of steels and the SPECTRUM program, the possibility of improving the metrological characteristics of the analysis of elements in low-alloy steel samples is shown.

For citation: Insaf I. Shakiryanov, Sait A. Bakhteev, Artem S. Maltsev, Rafail A. Yusupov. Metrological characteristics of the determination of chromium using separation of the useful signal from noise, background, harmful signals by the emission spectra of steels. *Butlerov Communications B*. **2021**. Vol.1. No.1. Id.1. DOI: 10.37952/ROI-jbc-B/21-1-1-17

References

[1] R.R. Gilazutdinova, S.A. Bakhteev, R.A. Yusupov. Regression analysis of the dependences of the analytical signals of Si, Mn, Cr on their concentrations in low-alloy steels. *Herald of Technological University*. **2015**. Vol.18. No.9. P.150-152. (Russian)

[2] V.V. Kravchenko, L.A. Minaeva. Application of atomic emission spectral analysis at OOO Usolye Siberian Silicon. *Youth Bulletin Irkutsk State Technical University*. **2012**. No.3. P.49. (Russian)

[3] Z.T. Dinh, S.A. Bakhteev, R.A. Yusupov Selection of a marker for signal normalization when analyzing Sn (II) in aqueous solutions by XRD. *Herald of Technological University.* **2012**. Vol.15. No.24. P.60-62. (Russian)

[4] K.I. Gabdulina, R.A. Yusupov, S.A. Bakhteev. Determination of Cd (II) concentration in process water by X-ray fluorescence analysis. *Herald of Technological University.* **2013**. Vol.16. No.9. P.38-39. (Russian)

[5] S. Maurice. ChemCam activities and discoveries during the nominal mission of the Mars Science Laboratory in Gale crater, Mars. *J. Anal. At. Spectrom.* **2016**. Vol.31. P.863-960.

[6] R. Gonzölez., M. Gaft, L. Nagli, Y. Grossmann, A. Barishnikov. Industrial Online Raw Materials Analyzer Based on Laser-Induced Breakdown Spectroscopy. *Appl, Spectrosc.* **2014**. Vol.68. No.9. P.1004.

[7] M. Gaft, L. Nagli, Y. Groisman, A. Barishnikov. Industrial Online Raw Materials Analyzer Based on Laser-Induced Breakdown Spectroscopy. *Appl, Spectrosc.* **2014**. Vol.68. No.9. P.1004.

[8] V. Sturm, R. Fleige, M. de Kanter, R. Leitner, K. Pilz, D. Fischer, G. Hubmer, R. Noll. Laser-Induced Breakdown Spectroscopy for 24/7 Automatic Liquid Slag Analysis at a Steel works. *Anal. Chem.* **2014**. Vol.86. P.9687.

[9] R. Noll, V. Sturm, U. Aydin, D. Eilers. Laser-induced breakdown spectroscopy – From research to industry, new frontiers for process control. *Spectrochim. Acta Part B.* **2008**. Vol.63. P.1159.

[10] S. Merk, C. Florek, D. Mory. Increased identification rate of scrap metal using Laser Inducted Breakdown Specroscopy Echelle spectra. *Spectrochim. Acta Part B.* **2015**. Vol.112. P.10.

[11] D.W. Hahn, N. Omenetto. Laser-Induced Breakdown Spectroscopy (LIBS), Part II: Review of Instrumental and Methodological approaches to Material Analysis and Applications to Different Fields. *Appl. Spectrosc.* **2012**. Vol.66. P.347.

[12] I.I. Shakiryanov, S.A. Bakhteev, S.G. Smerdova, A.S. Maltsev, R.A. Yusupov. An integrated system for analyzing the spectra obtained by the LIBS method to ensure the quality of measurements. *Butlerov Communications*. **2020**. Vol.64. No.11. P.83-87. DOI: 10.37952/ROI-jbc-1/20-64-11-83 (Russian)

[13] Insaf I. Shakiryanov, Sait A. Bakhteev, Artem S. Maltsev, Rafail A. Yusupov. Metrological characteristics of the determination of chromium using separation of the useful signal from noise, background, harmful signals by the emission spectra of steels. *Butlerov Communications*. **2021**. Vol.66. No.4. P.108-113. DOI: 10.37952/ROI-jbc-1/21-66-4-108 (Russian)